Dynamic Inertia Measurement Method (DIM)

Completed Technology Project (2013 - 2014)

Project Introduction

Critically important inertia measurements are complex and expensive to obtain due to the extensive fixturing and custom instrumentation of conventional techniques. This research effort has validated a more efficient, less risky, and faster inertia measurement technique for aerospace vehicles. The dynamic inertia measurement method is based on conventional ground vibration testing methods, which are routinely performed in other types of aircraft testing. The basic concept is to compute the inertia properties and center-of-gravity location of an object by measuring all forces acting on the object and the rigid body motion caused by these forces. Work to date: All testing has been completed and two technical papers describing the results have been published. The DIM method was implemented to measure the mass properties of the test article, as were then the conventional pendulum oscillation methods, to compare results, level of effort, and costs. The DIM method showed favorable results for the center of gravity and moments of inertia; however, the products of inertia showed appreciable disagreement with analytical predictions. Looking ahead: he next project phase, testing on an aerospace vehicle, has not yet been funded. Partner: ATA Engineering, Inc. provided software and support for the testing. Benefits Less risky: Does not require the vehicle to be suspended, reducing risk and equipment needs Less expensive: Eliminates the complex and expensive fixturing and equipment used in conventional measurement techniques Faster: Dramatically decreases testing and approval times by weeks or even months Applications Airplanes and space vehicles (capsules and lifting body spacecraft) Automobiles and other large terrestrial vehicles

Anticipated Benefits

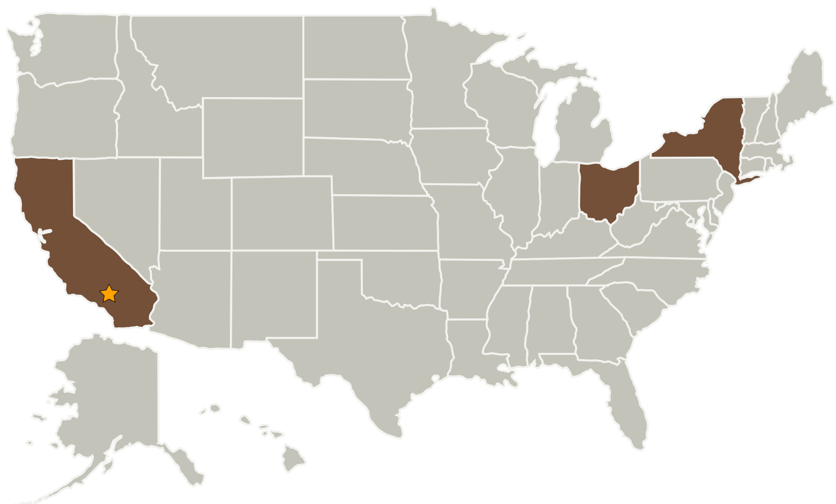
This technology has the potential to assist with a mission to determine mass properties of a vehicle. The approach offers several advantages.

- **Less risky:** Does not require the vehicle to be suspended, reducing risk and equipment needs
- **Less expensive:** Eliminates the complex and expensive fixturing and equipment used in conventional measurement techniques
- **Faster:** Dramatically decreases testing and approval times by weeks or even months

“Iron bird” test with the dynamic inertia measurement (DIM) method

Table of Contents

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California

Co-Funding Partners	Type	Location
ATA Engineering, Inc.	Industry	San Diego, California
PCB Piezotronics	Industry	
University of Cincinnati-Main Campus	Academia	Cincinnati, Ohio

Primary U.S. Work Locations	
California	New York
Ohio	

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Center Innovation Fund: AFRC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

David F Voracek

Project Manager:

Alexander W Chin

Principal Investigator:

Alexander W Chin

Co-Investigators:

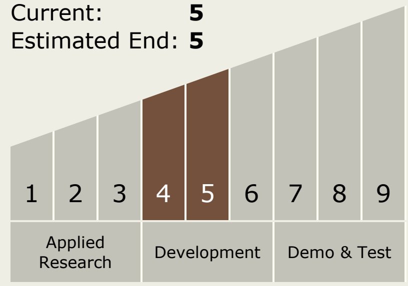
Claudia Y Sales
Natalie D Spivey

Images

"Iron bird" test with the dynamic inertia measurement (DIM) method
"Iron bird" test with the dynamic inertia measurement (DIM) method
(https://techport.nasa.gov/image/6593)

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  └ TX14.1 Cryogenic Systems
    └ TX14.1.2 Launch Vehicle Propellant